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Floristic indicators of tropical landuse systems: Evidence from mining areas in Southwestern Nigeria

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ABSTRACT

Most forests in the tropics have not only been reduced in size but have also experienced forest degradation. The delicate balance of the components of the forest ecosystem has been altered largely by the landuse systems which have resulted in the disappearance of some species and the introduction of new ones. In order to understand the influence of human disturbance caused by artisanal mining on plant biodiversity and the physical environment, this study assessed changes in vegetation characteristics using plant functional groups, such as invasive, pioneer and understory species. The study was conducted at two sites in two Southwestern states of Nigeria, Itagunmodi in Atakumosa West Local Government Area of Osun State and Olode in Oluyole Local Government Area of Oyo State. Complete enumerations of woody, non-woody and herbaceous plant species were carried out in 20 m by 20 m plots selected using stratified random sampling as representative of landuse classes: freshly mined (<6 months), abandoned mine (>6 months) and a control plot (secondary forest). The results showed that the control plot in Itagunmodi had undergone degradation as indicated by the presence of *Alchornea laxiflora*, *Geophilia obvallata, Musa sapientum, Elaeis guineensis* and *Keetia hispida.* However, if left undisturbed, it has the potential of regeneration back to its original state because of its woody tree species composition and lianas (*Triclisia gilletii*). In addition the forest soils in the mines had been exposed to direct insolation for a long period, and the soil structure and texture have been affected, consequently altering the viability of the seed bank. Poaceae and Papilionoideae were the most common in the freshly mined plots while invasive species were the most common in abandoned mined plots. In conclusion, the floristic composition in the mining sites has been altered and there was no clear evidence that regrowth would bring restoration of the lost ecosystem services.

1. Introduction

The lush tropical forest estate of southwestern Nigeria was a biodiversity sanctuary (Unwin, 1899). In just about a century, this once luxuriant tropical evergreen lowland rainforest had almost disappeared (Groombridge, 1992; Wilson, 1992). Their relics are found existing in forest patches across the landscape in conservation and ecologically sensitive areas (Salami, 2001). Increasing attention is now being placed on tropical secondary forests (Brown and Lugo, 1990; Finegan, 1992, 1996; Corlett, 1995; Guariguata and Ostertag, 2001). The effect of biodiversity loss is far reaching globally, most importantly, the current trend of climate change (Beaumont et al., 2008). The gradual disappearance of endemic plant species and the

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introduction of exotic species have further altered the delicate ecological balance affecting ecosystem functions and services. For example, the invasion of alien species causes changes in the forest estate with a consequent reduction in biodiversity and other forest goods and services, such as pollination, decomposition, seed dispersal, resilience and disease reduction (Chornesky et al., 2005). In addition, some native plant species are more important than others in providing ecosystem goods or services (Walker, 1992; Diaz et al., 2003). Plants species in this category are referred to as functional species and their loss often means a reduction in a given function. Forest degradation is a serious environmental, social and economic problem. Quantifying the scale of the problem is difficult, however, because forest degradation has many causes, it occurs in different forms and with varying intensity, and is perceived differently by different stakeholders.

Forest disturbances resulting from mining activities are on the increase in the Southwestern states of Nigeria that are rich in minerals (Salami et al., 2003; Akinbiola et al., unpublished). The type of mining that is predominant in Southwestern Nigeria is Artisanal and Small-scale Mining (ASM) which is responsible for over 95% of mining activities (Aigbedion and Iyayi, 2007; Mallo, 2012). Furthermore, ASM activities have risen to the forefront of environmental pollution problems in the interior parts of the country because their activity is largely uncoordinated and unregulated, due to informal nature of the sector (Mallo, 2012). ASM is largely a poverty-driven activity and, despite the fact that it is largely unlicensed, this activity provides livelihoods to growing numbers of rural people around the world (Adjei, 2007). The ASM of gold, tin/ columbite, lead/zinc, coal etc. has thrived in Nigeria since the advent of colonial mining around 1902 (Salami et al., 2003). The flora of the area where mining activities are ongoing and where abandoned mines exist is altered due to pollution and other factors, such as forest soil exposure to insolation, removal of the top soil and the subsoil from the mine pits, soil compaction and the mechanical breakage of the soil form when the forest is disturbed. In order to understand the extent of degradation and biodiversity loss, this study compares the floristic composition of the non-woody and herbaceous species in the mined and unmined areas in two different states in Southwestern Nigeria.

2. Materials and methods

2.1. Study area

The study was conducted in two mining sites from two states in Southwestern Nigeria, namely: Itagunmodi (Site 1), between 7°31′47.86″N, 4°38′53.54″E and 7°33′21.06″N, 4°39′04.90″E in Atakumosa West Local Government Area (LGA) of Osun state and Olode (Site 2), between 7°8′29.62″N, 3°54′51.13″E and 7°9′9.33″N, 3°54′45.68″E in Oluyole LGA of Oyo state (Fig. 1). Site 1 and 2 were selected from agrarian communities where cash crops such as cocoa and cola nut were produced in the pre-colonial times. However in recent times, this has changed to subsistence farming as the plantations have mostly disappeared and been replaced by food crops such as cassava, yam, and plantain (Adetoyinbo et al., 2010). Gold is the primary metal extracted from site 1. This metal can be found with pyrite, pyrrhotite and minor chalcopyrite, galena, sphalerite, magnetite and ilmenite (Elueze, unpublished). Breedt (1995) described the Site 1 mineralization as comprising of a series of auriferous quartz-carbonate veins localized by a subsidiary fault within biotite gneiss and mica schist. Site 2 lies in the basement complex of Oyo State. Rahaman et al. (1988) identified the major rock groups in Site 2 as gneiss, slightly magnetized to unmagnetized para-schist and older granite. Beryl and tourmaline are the two major minerals mined in Site 2.

2.2. Site selection

The study sites were selected based on the scale of operations and mining history which was more than 30 years. Furthermore, reconnaissance surveys were carried out to determine the landuse systems. The mined areas were identified with the assistance of subsistence miners present in the area while the control plots were chosen at a distance of at least 7 km away from the mined areas during reconnaissance visits.

2.3. Data collection

In the mining plots, areas of 20 m by 20 m were marked out for three landuse systems; freshly mined (<6 months), abandoned mine (>6 months) and the control plots located in the interior of the secondary forest, making a total of six plots. Complete enumerations of the non woody and herbaceous species were carried out. Unidentified plants were taken to the Ife Herbarium, at Obafemi Awolowo University, Ile-Ife, Nigeria. In addition, further confirmations were made on the British Royal Botanical Gardens (KEWS) online plant information portal.

2.4. Data analysis

The plant species were grouped into families and genera. Assessment of the plant species for forest degradation index and habitat conditions were carried out using (FAO, 2003).